

AMENDMENTS TO THE CLAIMS

1-15 (Cancelled)

16. (Currently Amended) A proton-conducting electrolyte membrane obtained by a process comprising the steps of:

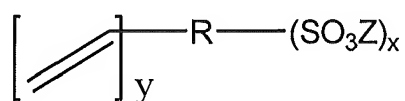
- a) swelling a polymer film with a liquid comprising a vinyl-containing sulphonic acid and vinyl-containing phosphonic acid, wherein the polymer film comprises after swelling at least 10% by weight vinyl-containing sulphonic acid and vinyl-containing phosphonic acid; and
- b) polymerizing the vinyl-containing sulphonic acid and vinyl-containing phosphonic acid present in the liquid introduced in step a),

wherein the membrane obtained in step (b) comprises at least 10% by weight of polyvinyl-containing phosphonic acid,
and wherein the conductivity of the membrane at temperatures of 160°C is at least 0.001 S/cm wherein this value is achieved without humidification and wherein the polyvinyl containing phosphonic and sulphonic acid formed in step b) forms an inter-penetrating network with the polymer of the polymer film from step a).

17. (Cancelled)

18. (Previously Presented) The membrane of Claim 16, characterized in that the polymers used in step a) are polymers that are stable at high temperatures and contain at least one nitrogen, oxygen, or sulphur atom in one or more repeat units.

19. (Previously Presented) The membrane of Claim 16, characterized in that the liquid comprising a vinyl-containing sulphonic acid contains compounds of the formula



wherein

y represents an integer 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10

$$\text{x}(\text{ZO}_3\text{S})-\text{R}-\text{C}(\text{R})=\text{C}(\text{R})-\text{R}-(\text{SO}_3\text{Z})_{\text{x}}$$

x represents an integer 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10

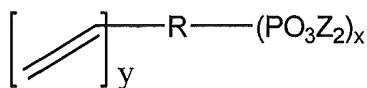
$$\begin{array}{c} \text{R}-(\text{SO}_3\text{Z})_x \\ \diagup \\ \text{=C} \\ \diagdown \\ \text{A} \end{array}$$

A represents a group of the formulae COOR^2 , CN , CONR_2^2 , OR^2 and/or R^2 , wherein R^2 represents hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or

- heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,
- R represents a bond, a divalent C1-C15 alkylene group, divalent C1-C15 alkyleneoxy group, in which the aforementioned radicals are optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,
- Z represents, independently of one another, hydrogen, C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, -OH, -CN, and
- x represents an integer 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10.

20. (Cancelled)

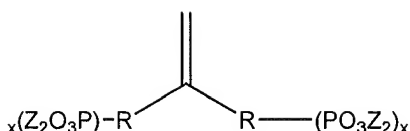
21. (Previously Presented) The membrane of Claim 16, characterized in that the liquid comprising a vinyl-containing sulphonic acid contains compounds of the formula



wherein

- R represents a bond, a C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,
- Z represents, independently of one another, hydrogen, C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, -OH, -CN, and
- x represents an integer 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10
- y represents an integer 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10

or of the formula



R represents a bond, a C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,

Z represents, independently of one another, hydrogen, C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, -OH, -CN, and

x represents an integer 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10

$$\begin{array}{c} \text{R}-(\text{PO}_3\text{Z}_2)_x \\ \diagup \\ \text{=C} \\ \diagdown \\ \text{A} \end{array}$$

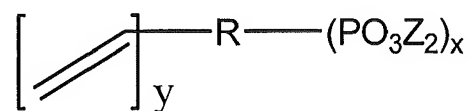
A represents a group of the formulae COOR^2 , CN , CONR_2 , OR^2 or R^2 , wherein R^2 represents hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, $-\text{OH}$, COOZ , $-\text{CN}$, NZ_2 ,

R represents a bond, a divalent C1-C15 alkylene group, divalent C1-C15 alkyleneoxy group, in which the aforementioned radicals are optionally substituted by halogen, $-\text{OH}$, COOZ , $-\text{CN}$, NZ_2 ,

Z represents, independently of one another, hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, $-\text{OH}$, $-\text{CN}$, and

x represents an integer 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10.

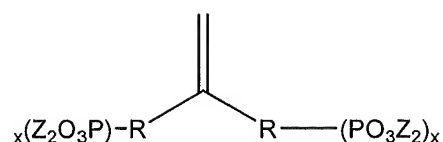
23. (Cancelled)
24. (Previously Presented) The membrane of Claim 16, characterized in that the liquid comprising a vinyl-containing sulphonic acid contains at least one substance capable of forming radicals.
25. (Previously Presented) The membrane of Claim 16, characterized in that the polymerization in step b) is carried out by irradiation with IR or NIR light, UV-light, β , γ and/or electron rays.
- 26-27. (Cancelled)
28. (Previously Presented) The membrane of Claim 16, characterized in that the membrane comprises a layer containing a catalytically active component.
29. (Previously Presented) The membrane of Claim 16, characterized in that the liquid comprising a vinyl-containing sulphonic acid contains phosphonic acid and compounds of the formula



wherein

- R represents a bond, a C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,
- Z represents, independently of one another, hydrogen, C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, -OH, -CN, and
- x represents an integer 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10
- y represents an integer 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10

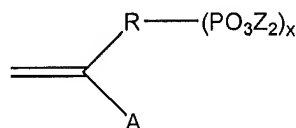
or of the formula



wherein

- R represents a bond, a C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,
- Z represents, independently of one another, hydrogen, C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, -OH, -CN, and
- x represents an integer 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10

or of the formula



wherein

- A represents a group of the formulae COOR², CN, CONR²₂, OR² or R², wherein R² represents hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,
- R represents a bond, a divalent C1-C15 alkylene group, divalent C1-C15 alkyleneoxy group, in which the aforementioned radicals are optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,
- Z represents, independently of one another, hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, -OH, -CN, and
- x represents an integer 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10; and

the ratio by weight of vinyl-containing phosphonic acid to vinyl-containing sulphonic acid lies in the range of 1:100 to 99:1.

30-35. (Cancelled)

36. (Previously Presented) The proton-conducting electrolyte membrane of Claim 16, wherein the liquid swollen polymer film comprises after swelling at least 30% by weight vinyl-containing sulphonic.

37-39. (Cancelled)

40. (Previously Presented) The proton-conducting electrolyte membrane of Claim 16, wherein the proportion of polyvinyl-containing phosphonic acid is from 10% to 97% by weight.

41. (Previously Presented) The proton-conducting electrolyte membrane of Claim 16, wherein the membrane obtained in step (b) comprises between 1% and 90% by weight of the polymer.

42. (Currently Amended) A proton-conducting electrolyte membrane obtained by a process comprising the steps of:

- a) swelling a polymer film with a liquid comprising a vinyl-containing sulphonic acid and vinyl-containing phosphonic acid, wherein the polymer film comprises after swelling at least 10% by weight vinyl-containing sulphonic acid and vinyl-containing phosphonic acid; and
- b) polymerizing the vinyl-containing sulphonic acid and vinyl-containing phosphonic acid present in the liquid introduced in step a),

wherein the membrane obtained in step (b) comprises from 20% to 95% by weight of polyvinyl-containing phosphonic acid,
and wherein the conductivity of the membrane at temperatures of 160°C is at least 0.001 S/cm wherein this value is achieved without humidification and

wherein the polyvinyl containing phosphonic and sulphonic acid formed in step b) forms an inter-penetrating network with the polymer of the polymer film from step a).

43. (Currently Amended) A proton-conducting electrolyte membrane obtained by a process comprising the steps of:

- a) swelling a polymer film with a liquid comprising a vinyl-containing sulphonic acid and vinyl-containing phosphonic acid, wherein the polymer film comprises after swelling at least 10% by weight vinyl-containing sulphonic acid and vinyl-containing phosphonic acid; and
- b) polymerizing the vinyl-containing sulphonic acid and vinyl-containing phosphonic acid present in the liquid introduced in step a),

wherein the liquid used in step (a) comprises vinyl-containing phosphonic acid in the amount of at least 20% by weight, thereby imparting onto the proton-conducting electrolyte membrane obtained in step (b) the conductivity at temperatures of 160°C of at least 0.001 S/cm

wherein this value is achieved without humidification and

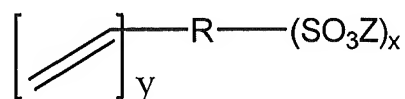
wherein the polyvinyl containing phosphonic and sulphonic acid formed in step b) forms an inter-penetrating network with the polymer of the polymer film from step a).

44. (Withdrawn) A process for producing a proton-conducting electrolyte membrane which comprises

- a) swelling a polymer film with a liquid comprising a vinyl-containing sulphonic acid and vinyl-containing phosphonic acid, wherein the polymer film comprises after swelling at least 10% by weight vinyl-containing sulphonic acid and vinyl-containing phosphonic acid; and
- b) polymerizing the vinyl-containing sulphonic acid and vinyl-containing phosphonic acid present in the liquid introduced in step a),

wherein the membrane obtained in step (b) comprises at least 10% by weight of polyvinyl-containing phosphonic acid,
and wherein the conductivity of the membrane at temperatures of 160°C is at least 0.001 S/cm.

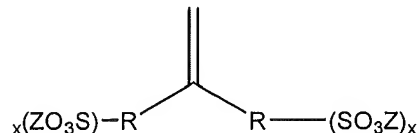
45. (Withdrawn) The process as claimed in claim 44, wherein the membrane has an intrinsic conductivity of at least 3 mS/cm at 160 °C and wherein the process is carried out without humidification.
46. (Withdrawn) The process as claimed in claim 44, wherein the polymers used in step a) are polymers that are stable at high temperatures and contain at least one nitrogen, oxygen, or sulphur atom in one or more repeat units.
47. (Withdrawn) The process as claimed in claim 44 wherein the liquid comprising a vinyl-containing sulphonic acid contains compounds of the formula



wherein

- R represents a bond, a C1-C15 alkyl group, a C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, -OH, COOZ, -CN, or NZ₂,
- Z represents, independently of one another, hydrogen, C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, -OH, -CN, and
- x represents an integer 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10
- y represents an integer 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10

or the formula



wherein

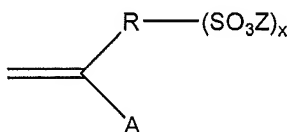
- R represents a bond, a C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which

the aforementioned radicals are optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,

Z represents, independently of one another, hydrogen, C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, -OH, -CN, and

x represents an integer 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10

or the formula



wherein

A represents a group of the formulae COOR², CN, CONR²₂, OR² and/or R², wherein R² represents hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,

R represents a bond, a divalent C1-C15 alkylene group, divalent C1-C15 alkyleneoxy group, in which the aforementioned radicals are optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,

Z represents, independently of one another, hydrogen, C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, in which the aforementioned radicals are optionally substituted by halogen, -OH, -CN, and

x represents an integer 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10.

48. (Withdrawn) The process as claimed in claim 44 wherein the liquid comprising a vinyl-containing sulphonic acid contains at least one substance capable of forming radicals.

49. (Withdrawn) The process as claimed in claim 44 wherein the polymerization in step b) is carried out by irradiation with IR or NIR light, UV-light, β , γ and/or electron rays.
50. (Withdrawn) The process as claimed in claim 44 wherein the liquid swollen polymer film comprises after swelling at least 30% by weight vinyl-containing sulphonic.